

Wind Tunnel

Activity Objectives

- To demonstrate the effects flight control surfaces manipulation has upon the plane and its flight characteristics
- To demonstrate on a small scale how scientists test those characteristics on larger planes and rockets
- To realize some of the benefits which may occur from scientific “modeling”

Materials

- ✓ A piece of furnace pipe or carpet roll about 1.3 meters long
- ✓ A piece of transparency film for the tunnel window
- ✓ Separation from an egg carton (available at the grocery store, some bakeries, a restaurant, or you may build a similar one from strips of light cardboard)
- ✓ Heavy cardboard or a box the same size as the egg carton divider
- ✓ Book tape or duct tape
- ✓ An electric fan
- ✓ Two small hooks (cup hanger hooks)
- ✓ Metal shears or saber saw (depending on the material used to construct your tunnel)

Background

The tunnel-like chambers through which air is passed at different velocities are used to study airflow over an object like a plane or rocket. The automobile industry also uses wind tunnels in their research to produce more fuel efficient cars. Some of the wind tunnels in the United States are large enough to hold full-size planes or rockets. One such tunnel is located at the NASA Research facility in Langley, Virginia. A supersonic tunnel is at the NASA Lewis Research Center in Cleveland, Ohio. A model of the shuttle was tested and perfected in this tunnel.

There are any number of small wind tunnels which you or students can construct. The one suggested here is a relatively simple one requiring minimum materials. If you would like to prepare a more sophisticated model, refer to additional sources such as science teacher resource manuals.

Instructions

1. Open the carton separators and strengthen the corners with tape.
2. Open a box at both ends and place the separator grid into the box. It should be a snug fit.
3. Cut a window near one end of the roll or pipe and cover it with the clear film or acetate.
4. Tape the film down using the book binder or duct tape.
5. Fasten the hooks on opposite sides of the tube so that a plane hanging from the top hook will be positioned in from of the window.
6. Set the egg carton separations flush against the pipe or tube and place a fan in the box holding the separators. The separators will straighten the swirling air from the fan.
7. Prepare a suspension system for the models to be tested:
 - Use a strong rubber band, the type you find on model airplanes. Cut the band in one place.
 - String two note book paper reinforcement rings on the rubber band and glue together.
 - Tie the cut ends of the rubber band back together again.
 - Attach the model to be tested by placing a pin through the model and the ring near the model's center of gravity.
 - Attach a similar rubber band to the lower hook.
8. Have the students begin by building paper airplane models and testing the effects of manipulation of the control surfaces of the model. They should discover that to climb, the elevators are up; to dive the elevators are down; to turn right, the rudder is right, the right aileron is up, the left aileron is down; to turn left, the rudder is left, the left aileron is up and the right aileron is down.
9. Have the students investigate the effects of changing the center of gravity on the stability of the plane.

Extension

Have the students prepare and test model rockets in the tunnel before actual flight. Compare the actual flight results with the data collected from the wind tunnel tests. Have students research wind tunnel testing on automobiles and investigate the spinoffs from the science of aerodynamics to the auto industry.